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JC18 Rec'd PCT/PTO 29 JUN 2001

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June 29, 2001

BOX PCT

Commissioner for Patents
Washington, D.C. 20231

PCT/FR99/03299

-filed December 28, 1999

Re: Application of Gérard MOUGEY
DEVICE FOR IMPROVING GAS FUEL BURNING
Assignee: TOTAL RAFFINAGE DISTRIBUTION S.A.
Our Ref: Q64953

Dear Sir:

The following documents and fees are submitted herewith in connection with the above application for the purpose of entering the National stage under 35 U.S.C. § 371 and in accordance with Chapter II of the Patent Cooperation Treaty:

- ☒ an English translation of the International Application.
- ☒ two (2) sheets of drawings.
- ☒ an English translation of Article 34 amendments.
- ☒ a Preliminary Amendment

The Declaration and Power of Attorney, Assignment, will be submitted at a later date.

It is assumed that copies of the International Application, the International Search Report, the International Preliminary Examination Report, and any Articles 19 and 34 amendments as required by § 371(c) will be supplied directly by the International Bureau, but if further copies are needed, the undersigned can easily provide them upon request.

The Government filing fee is calculated as follows:

Total claims	<u>3</u>	-	20	=	<u> </u>	x	\$18.00	=	<u> </u>	\$.00
Independent claims	<u>1</u>	-	3	=	<u> </u>	x	\$80.00	=	<u> </u>	\$.00
Base Fee										\$860.00

TOTAL FEE

\$860.00

A check for the statutory filing fee of \$860.00 is attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.492 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from December 30, 1998 based on French Application No. 98/16621.

Respectfully submitted,

Robert J. Seas, Jr.

Registration No. 21,092

RJS/amt

09/869523

JC18 Rec'd PCT/PTC 29 JUN 2001

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Gerard MOUGEY

Appln. No.: PCT/FR99/03299

Group Art Unit: Not Yet Assigned

Confirmation No.: Not Yet Assigned

Examiner: Not Yet Assigned

Filed: June 29, 2001

For: DEVICE FOR IMPROVING GAS FUEL BURNING

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE CLAIMS:

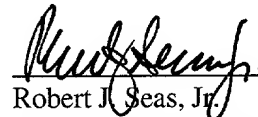
Please enter the following amended claim:

3. Device according to claim 1, characterized in that the diameter of the central tube (1) is different, and preferably greater in diameter than the annularly arranged tubes (6).

REMARKS

Entry and consideration of this Amendment is respectfully requested.

Respectfully submitted,



Robert J. Seas, Jr.
Registration No. 21,092

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Date: June 29, 2001

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims are amended as follows:

3. Device according to ~~either of claims 1 and 2~~claim 1, characterized in that the diameter of the central tube (1) is different, and preferably greater in diameter than the annularly arranged tubes (6).

2/PR75

09/869523
JC18 Rec'd PCT/PTO 29 JUN 2001

DEVICE FOR IMPROVING GAS FUEL BURNING

The invention concerns a device for bringing together a gas fuel and an oxidant in proportions providing optimal burning, so as to obtain, in particular for a fuel gas supplied with low pressure level and containing hydrocarbons, a smokeless burning.

STATUS OF THE TECHNOLOGY

It is known that the ratio between the flow of gas to be burned and the air flow required for combustion should at all times be equal to or greater than the stoichiometric ratio in order for a burner to be able to operate entirely independently with no additional supply of external air. It is also known that the combustion of gas containing hydrocarbons, to burn off waste gases containing hydrogen sulfide, for example, or gas emissions containing hydrocarbons at an oil refinery or oil or gas production field, must meet three essential conditions, generally called "the three T's" in the industry, to obtain optimal combustion.

In effect, if the quantity of air required for combustion is insufficient and if these three T's, that is, the Temperature of the flame, the Time the air and gas are mixed before burning, and the Turbulence applied to this mixture, are not observed, foul smelling odors and thick black smoke, essentially composed of unburned hydrocarbons, are emitted by the incomplete combustion of these gases or gaseous emissions, thus harming the environment.

One of the major causes of this incomplete combustion, and particularly of the appearance of black smoke at the point of combustion, is therefore primarily the result of an insufficient amount of air, detrimental to good combustion free of unburned hydrocarbons. Indeed, when the flow of gas to be burned is large, for example, and the supply pressure of this fuel gas is very low, commercially available burners are generally ineffective in permitting aeration of the flame sufficiently activated by the pressure of the gas coming out of the supply tube of the burner. An external supply of air needed for combustion must therefore be provided, by any means available in the technology, for example by supplying a fuel-oxidant mixture energy by means of water vapor.

Devices have been proposed to obtain sufficient mixing energy from large quantities of air, using external fluids such as water vapor going through injectors, or other fluids acting as “motive fluids,” for example when the air itself is compressed, or using powerful blowers to induce the air and turbulence required for combustion. These devices generally have low yields, so in order to compensate for their lack of efficiency it is necessary to use large quantities of motive fluids which are not always available in the amounts required on the waste gas combustion site.

As a result, when water vapor is used as a motive fluid, for example, the high rate of consumption produces the following disadvantages:

- high noise emission due to the passage of the fluid in the tubes and injectors,
- a cooling of the flame so that the correct conditions for combustion of the gases are not ensured; for example, acidic gases such as H_2S , for which the temperature of $700^{\circ}C$ required for complete oxidation is not reached under these conditions, resulting in toxic and foul smelling emissions.
- an energy balance on the site could be deficient because of the dependence on production of water vapor.

In oil and gas production fields, water vapor is generally not available, and because the pressure of gas to be burned is too low to act as motive gas, that is, that the gas itself could entrain enough air needed for its combustion and thus obtain sufficient fuel-oxidant mixing energy, the combustion of these gases containing hydrocarbons is therefore incomplete, resulting in thick black smoke from the burning site.

Manufacturers of burners have proposed a system of aeration of the flame of a burner that consists of supplying air for the combustion by means of high power blower units arranged beneath the burner, and by using automatic valves to control the distribution of gas in accordance with the capacity to be burned. There is an unacceptable risk of failure in this system, controlled by complex instrumentation, because a dangerous obstruction could be created in the manifold of gases to be burned at a refinery, when for example an automatically controlled valve remains in the closed position. Furthermore, this system for aeration of the flame proves to have a high capital cost and operating expenses even while it is not very reliable and generates safety

problems when the gas to be burned contains liquid hydrocarbons, also called condensates, easily flammable, which can fall on the blowers arranged beneath the burner.

FR-A- 2 095 661 deals with an air aspirator using as a motive fluid a gas under pressure, the nature of which is not specified. This air aspirator has a plurality of gas injection tubes arranged in two concentric rings at the input of a venturi tube open to the atmosphere and the axes of which are parallel to the axis of the venturi tube.

US-A 2 403 431 describes a fuel gas burner having a plurality of injection tubes arranged at the input of a venturi tube open to the atmosphere. These tubes, parallel to the axis of the venturi tube, are supplied with a premixture of fuel gas and air, this premixture coming from another venturi tube placed upstream and open to the atmosphere or connected to a source of air under pressure.

European patent No. 99 828, held by the Applicant, proposes a device for the combustion of mixtures of fuel fluids with air induction, in which these fluids are introduced into a burner body forming a venturi, by means of injectors with annular cross section arranged coaxially along the axis of said body. Such a device has the major disadvantage of being difficult to produce because it requires extremely careful machining. Moreover, it seemed desirable to improve its performance in order to improve the efficiency of the device and particularly the homogeneity of the fluid ejection velocity profile in the mixing tube of the venturi forming the burner.

The applicant has therefore done research to find solutions that are technologically satisfactory, simple, reliable, with low capital cost at a refinery as well as at a production site, to provide sufficient quantities of air for burning a gas fed under low pressure and containing hydrocarbons, while improving the conditions required for optimal combustion of this gas and in particular to obtain smokeless combustion.

SUMMARY DESCRIPTION OF THE INVENTION

An object of the invention, therefore, is a device for the combustion of gas containing hydrocarbons that can be burned in the presence of air, in which the fuel gas arrives by a central supply comprising a tube

situated in the axis of a body forming a venturi, characterized in that a plurality of gas supply tubes are arranged in at least one ring around the central supply of the body forming a venturi, at least the ends of these tubes having their axes appreciably parallel to the wall of the mixing tube of this venturi.

Thus the device according to the invention has the particular advantage of allowing the complete combustion of a gas containing hydrocarbons, with no smoke, even when the pressure of the fuel gas is low and it contains condensates.

Other advantages and characteristics of the device according to the invention will be brought out in the description, to which are appended, solely for purposes of illustration, figures 1, 2a and 2b.

DESCRIPTION OF THE FIGURES

Figure 1 diagrammatically represents a front view of a device according to the invention, in cross section along I-I.

Figure 2a diagrammatically represents a top view of the device of figure 1 with a plurality of tubes arranged annularly in a single ring the center of which is located on the axis of the body forming a venturi.

Figure 2b diagrammatically represents a top view of a variation of the device of figure 1, with a plurality of tubes distributed in two rings.

DETAILED DESCRIPTION OF THE INVENTION

The device according to the invention, as represented in figures 1 and 2a, comprises a central fuel gas supply 1 arranged at the center and at the input of a body 2 forming a venturi. The body 2 has a conical lower part 3 generally called "mixer head" and which is extended by a cylindrical part 4 called "neck." This cylindrical part 3 [sic] is extended by a conical upper part 5 called "mixing tube."

The central gas supply 1 generally has a central tube with annular cross section and which is essentially coaxial with the body 2. This central tube extends from the exterior into the mixer head 3 up to a point situated in the body 2, generally at the level of the juncture of the mixer head 3 and the neck 4.

According to the invention, a plurality of additional tubes 6 is provided around the central supply 1. The device according to the invention has at least three tubes arranged annularly, while the maximum number of tubes can reach several dozen, depending on the size of the body forming a venturi 2. The arrangement of the tubes 6 is generally regular and annular, as can be seen in figures 2a and 2b.

Preferably these additional tubes 6 are essentially identical, have an essentially circular cross section and are arranged annularly around the central supply 1, with at least the axis of their end essentially parallel to the wall of the mixing tube 5 of the body forming a venturi, in order to inject the fuel gas into said body while forming an angle α with the axis AA of this body forming a venturi. Their lower part 8 can be cylindrical and essentially parallel to the axis AA of the body 2, while, as can be seen in figure 1, the angle of inclination α of the upper part 7 with respect to the axis AA is essentially equal to the angle of inclination of the mixing tube 5 with respect to this same axis AA. In one variation of the invention not represented in the figures, the axes of the tubes can form an angle with the axis of the body forming a venturi, equal to the one that the mixing tube forms with the axis of said body.

The tubes can be arranged, as shown in figure 2b, annularly around the central fuel gas supply tube, in several rings the centers of which are situated on the axis AA of the body forming a venturi 2.

The additional tubes 6 penetrate into the body 2 very generally at the same depth, which can be the same or less than the depth of penetration of the central tube 1 in the body 2. This central tube can have a different diameter, preferably greater than the diameter of the annularly arranged tubes.

Each tube 6 is sized in such a way that, on the one hand its inside diameter is identical to that of all of the tubes arranged annularly in at least one ring, and on the other hand it can carry between 1% and 33% and preferably between 5% and 33% of the fuel gas. Moreover, the ends of all of the tubes arranged in at least one ring can be fitted with gas injection devices such as injection nozzles.

The central tube 1 as well as the additional tubes 6 arranged in at least one ring can all be connected to the same fuel gas supply tube 9. In this case, they are connected by means of the supply tube 9 to a source of fuel gas, which can be composed, for example, of hydrocarbons, hydrogen sulfide H_2S or a mixture of these gases.

The combustion is produced at the outlet of the tubes 1 and 6, inside the body 2, but because of the presence of both the central tube 1 and the additional tubes 6, a better distribution of gas velocities is produced than that observed

with standard burners, which promotes the exchanges as well as the turbulences between the motive fluid and the oxidant, i.e., the fuel gas leaving the tubes and the induced fluid, i.e., the air. The result is high performance in the entrainment of this air, which can be quantified by a general rate of dilution of the fuel gas in the air on the order of 40. (In comparison, standard burners have a dilution rate of 3 to 10.) Moreover, the entrainment of air by the device according to the invention is very high even when the device is supplied with a motive fluid at very low pressure.

The applicant has performed tests on a burner on the ground called "burn pit." When a standard burner is used, composed of a single feed tube for the gas to be burned and a venturi having only one central supply tube, the production of thick black smoke is noted, evidence of incomplete combustion of the gases. However, when the device according to the invention is installed under the same conditions of high flow rate and low pressure of the fuel gas, smokeless combustion is obtained. In addition, the condensates entrained in the flame also burn without smoke. In order to obtain complete combustion with the standard burner, a gas pressure 30 times greater would be needed.

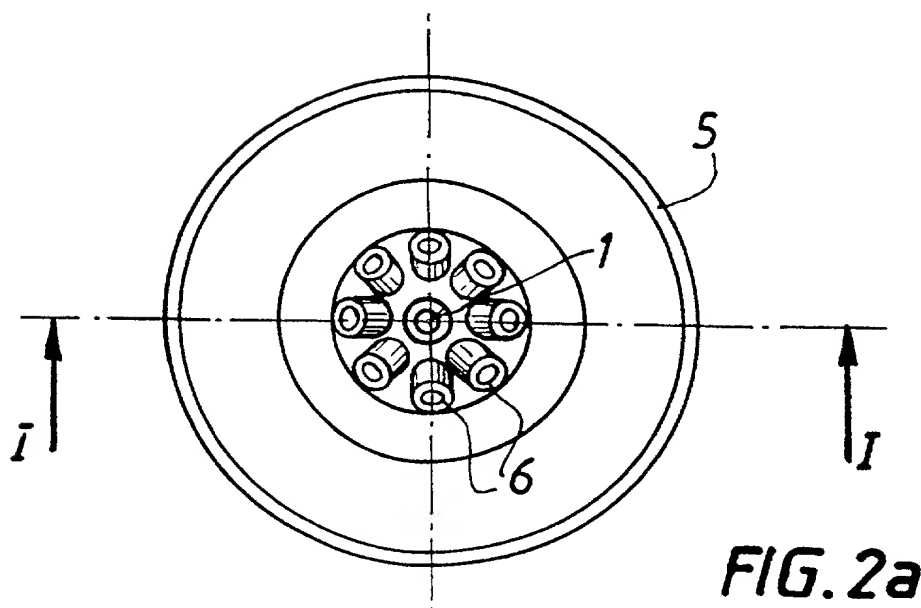
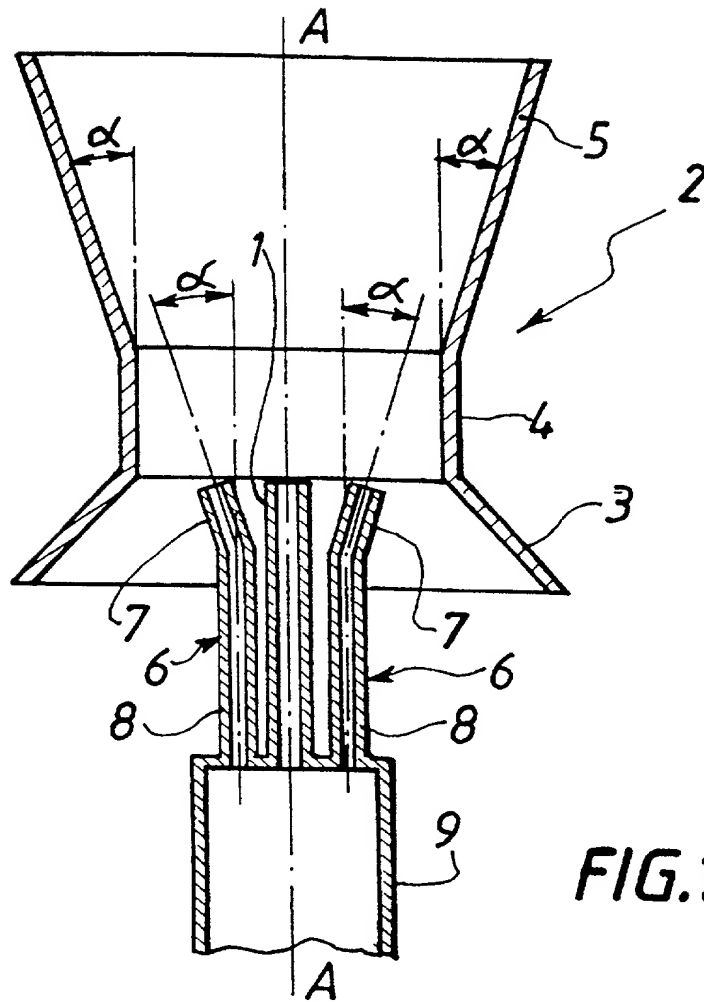
Furthermore, the use of the device according to the invention produces operating conditions that favor the reduction of nitrogen oxides, such as combustion air in stages, the elimination of very hot areas of the flame by homogenization of its temperatures. This is clearly important, because it has been established that nitrogen oxides formed during combustion contribute to the acidification process, photochemical pollution, decrease in the ozone layer and increase in the greenhouse effect.

CLAIMS

1. Device for the combustion of gas containing hydrocarbons that can be burned in the presence of air, in which the fuel gas arrives by a central supply (1) comprising a tube situated in the axis of a body forming a venturi (2), characterized in that a plurality of gas supply tubes (6) are arranged in at least one ring around the central supply (1) of the body forming a venturi (2), at least the ends of these tubes having their axes appreciably parallel to the wall of the mixing tube (5) of this venturi.

2. Device according to claim 1, characterized in that each annularly arranged tube (6) is sized in such a way that it can carry between 1% and 33%, and preferably between 5% and 33% of said gas.

3. Device according to either of claims 1 and 2, characterized in that the diameter of the central tube (1) is different, and preferably greater in diameter than the annularly arranged tubes (6).



2/2

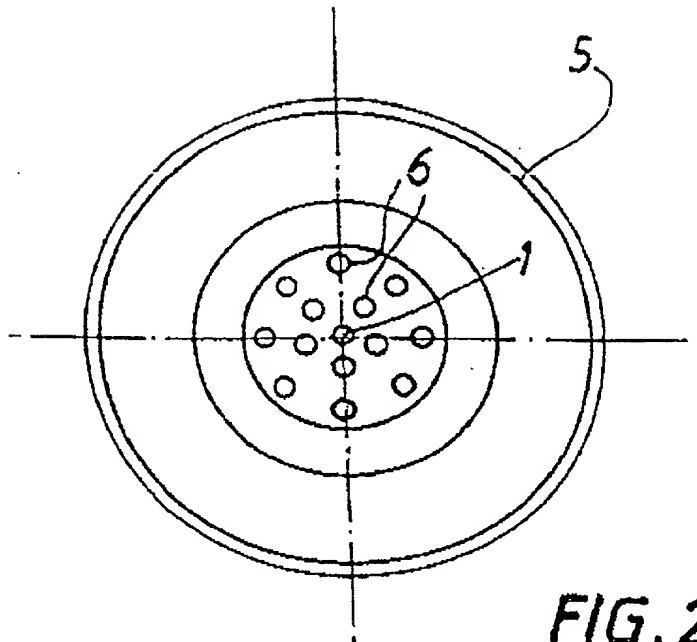


FIG. 2b

Declaration and Power of Attorney for Patent Application

Déclaration et Pouvoirs pour Demande de Brevet

French Language Declaration

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que:

Mon domicile, mon adresse postale et ma nationalité sont ceux figurant ci-dessous à côté de mon nom.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée

et dont la description est fournie ci-joint à moins que la case suivante n'ait été cochée:

a été déposée le
sous le numéro de demande des Etats-Unis ou le numéro
de demande international PCT
_____ et modifiée le
_____ (le cas échéant).

Je déclare par le présent acte avoir passé en revue et compris le contenu de la description ci-dessus, revendications comprises, telles que modifiées par toute modification dont il aura été fait référence ci-dessus.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

DEVICE FOR IMPROVING GAS FUEL BURNING

the specification of which is attached hereto unless the following box is checked:

☒ was filed on December 28, 1999
as United States Application Number or PCT
International Application Number PCT/FR99/03299
(Confirmation No. [_____])
and was amended on February 1, 2001
_____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119(a)-(d) ou § 365(b) du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, § 365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les Etats-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

Prior foreign application(s)
Demande(s) de brevet antérieure(s)

98/16621	France
(Number)	(Country)
(Numéro)	(Pays)
<hr/>	
(Number)	(Country)
(Numéro)	(Pays)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 119(e) du Code des Etats-Unis, de toute demande de brevet provisoire effectuée aux Etats-Unis et figurant ci-dessous.

(Application No.)	(Filing Date)
(N° de demande)	(Date de dépôt)
<hr/>	
(Application No.)	(Filing Date)
(N° de demande)	(Date de dépôt)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis, ou en vertu du Titre 35, § 365(c) du même Code, de toute demande internationale PCT désignant les Etats-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande:

(Application No.)	(Filing Date)
(N° de demande)	(Date de dépôt)
<hr/>	
(Application No.)	(Filing Date)
(N° de demande)	(Date de dépôt)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby claim foreign priority under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed
Droit de priorité non revendiqué

December 30, 1998	<input type="checkbox"/>
(Day/Month/Year Filed)	
(Jour/Mois/Année de dépôt)	
<hr/>	
(Day/Month/Year Filed)	<input type="checkbox"/>
(Jour/Mois/Année de dépôt)	

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Status)(patented, pending, abandoned)	
(Statut)(breveté, en cours d'examen, abandonné)	
<hr/>	
(Status)(patented, pending, abandoned)	
(Statut)(breveté, en cours d'examen, abandonné)	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

French Language Declaration

POUVOIRS: En tant que l'inventeur cité, je désigne par la présente l'(les) avocat(s) et/ou agent(s) suivant(s) pour qu'ils poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire s'y rapportant avec l'Office des brevets et des marques: (mentionner le nom et le numéro d'enregistrement).

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: (list name and registration number)

John H. Mion, Reg. No. 18,879; Thomas J. Macpeak, Reg. No. 19,292; Robert J. Seas, Jr., Reg. No. 21,092; Darryl Mexic, Reg. No. 23,063; Robert V. Sloan, Reg. No. 22,775; Peter D. Olexy, Reg. No. 24,513; J. Frank Osha, Reg. No. 24,625; Waddell A. Biggart, Reg. No. 24,861; Louis Gubinsky, Reg. No. 24,835; Neil B. Siegel, Reg. No. 25,200; David J. Cushing, Reg. No. 28,703; John R. Inge, Reg. No. 26,916; Joseph J. Ruch, Jr., Reg. No. 26,577; Sheldon I. Landsman, Reg. No. 25,430; Richard C. Turner, Reg. No. 29,710; Howard L. Bernstein, Reg. No. 25,665; Alan J. Kasper, Reg. No. 25,426; Kenneth J. Burchfiel, Reg. No. 31,333; Gordon Kit, Reg. No. 30,764; Susan J. Mack, Reg. No. 30,951; Frank L. Bernstein, Reg. No. 31,484; Mark Boland, Reg. No. 32,197; William H. Mandir, Reg. No. 32,156; Brian W. Hannon, Reg. No. 32,778; Abraham J. Rosner, Reg. No. 33,276; Bruce E. Kramer, Reg. No. 33,725; Paul F. Neils, Reg. No. 33,102; and Brett S. Sylvester, Reg. No. 32,765; Robert M. Masters, Reg. No. 35,603; George F. Lehnigk, Reg. No. 36,359; John T. Callahan, Reg. No. 32,607; Steven M. Gruskin, Reg. No. 36,818; Peter A. McKenna, Reg. No. 38,551 and Edward F. Kenahan, Reg. No. 28,962

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Send Correspondence to:

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Washington, D.C. 20037-3213

Adresser tout appel téléphonique à:
 (nom et numéro de téléphone)

Direct Telephone Calls to: 202-293-7060
 (name and telephone number)

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Signature de l'inventeur	Date	Inventor's signature	27/8/01
Domicile		Residence	8, rue des Capucins 14600 HONELEUR FRANCE FRX
Nationalité		Citizenship	FRENCH
Adresse postale		Post Office Address	Same as Residence
Nom complet du second co-inventeur, le cas échéant		Full name of second joint inventor, if any	
Signature du second inventeur	Date	Second inventor's signature	Date
Domicile		Residence	
Nationalité		Citizenship	
Adresse postale		Post Office Address	